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ABSTRACT

To assist the formation of IMS (Instructional Management System) configurations, three categories of characteristics are developed and explained. Categories 1 and 2 emphasize automation, and the necessity of forming workable configurations to carry out instructional management for Southwest Regional Laboratory developed instructional and/or learning mastery systems. Category 3 delineates IMS school structural, test structural, and report structural characteristics. A wide range of criteria, in whose context the interaction of these characteristics is to be assessed, are also described, including cost-benefit, physical realizability and availability, reliability, maintenance, flexibility, and security. (SK)

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TITLE: CRITERIA UNDERLYING THE FORMATION OF ALTERNATIVE IMS CONFIGURATIONS

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ABSTRACT

Three categories have been developed to assist the formation of a finite number of IMS configurations. Categories 1 and 2 emphasize automation, and the necessity of forming workable configurations to carry out instructional management for SWRL-developed instructional and/or learning mastery systems. Category 3 delineates IMS school structural, test structural, and report structural characteristics. A wide range of criteria, in whose context the interaction of these characteristics will be assessed, are also described. An IMS Modal Unit portrays a quantitative flow of information to aid the formation and analysis of alternative configurations.

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CRITERIA UNDERLYING THE FORMATION OF ALTERNATIVE IMS CONFIGURATIONS

TM 5-72-02 identified the operational features of a realizable Instructional Management System (IMS) configuration. Various available and potential means of accomplishing these operational features were also briefly described. It is clear that an innumerable number of IMS configurations could be formed to accomplish the operational features. In this paper, three categories are defined which may govern the formation and analysis of alternative configurations.

CATEGORY 1

Each configuration alternative will be computer-based. Automation at all possible stages of the system will be employed to minimize human intervention and manipulation of the source data and of the processing sequence.

CATEGORY 2

Each alternative configuration will employ state-of-the-art techniques and hardware; theoretical optimality will be determined at a later stage utilizing computer simulation techniques. All the configurations will be initially formed with the intent of carrying out computer-based instructional management for SWRL-developed instructional and/or learning mastery systems whose characteristics can be firmly specified.

CATEGORY 3

Three types of characteristics--school (user group) structural, test (input) structural, and report (output) structural, are described

(Fig. 1) in this category to assist delineation of the operational limits of alternative configurations. The quantitative figures in these characteristics have been assigned limits ranging from a practical lower to a predictable upper. A Modal Unit is logically derived from the limits to form a reasonable environment for alternative configurations. The alternative configurations will be formed to satisfy the Modal Unit requirements, and should have the capability and flexibility to be expanded to efficiently cover the predictable upper limits of the structural characteristics. The frequency/quantity of data/information flow in the Modal Unit are depicted in Figure 2.

Data input and information output will also occur at times other than for standard fixed inputs/outputs (as in cases of new student arrivals and transfers, late test data, special queries, etc.).

The interaction of these structural characteristics will be assessed in the context of the following constraints and/or criteria.

Cost Minimization/Benefit Maximization

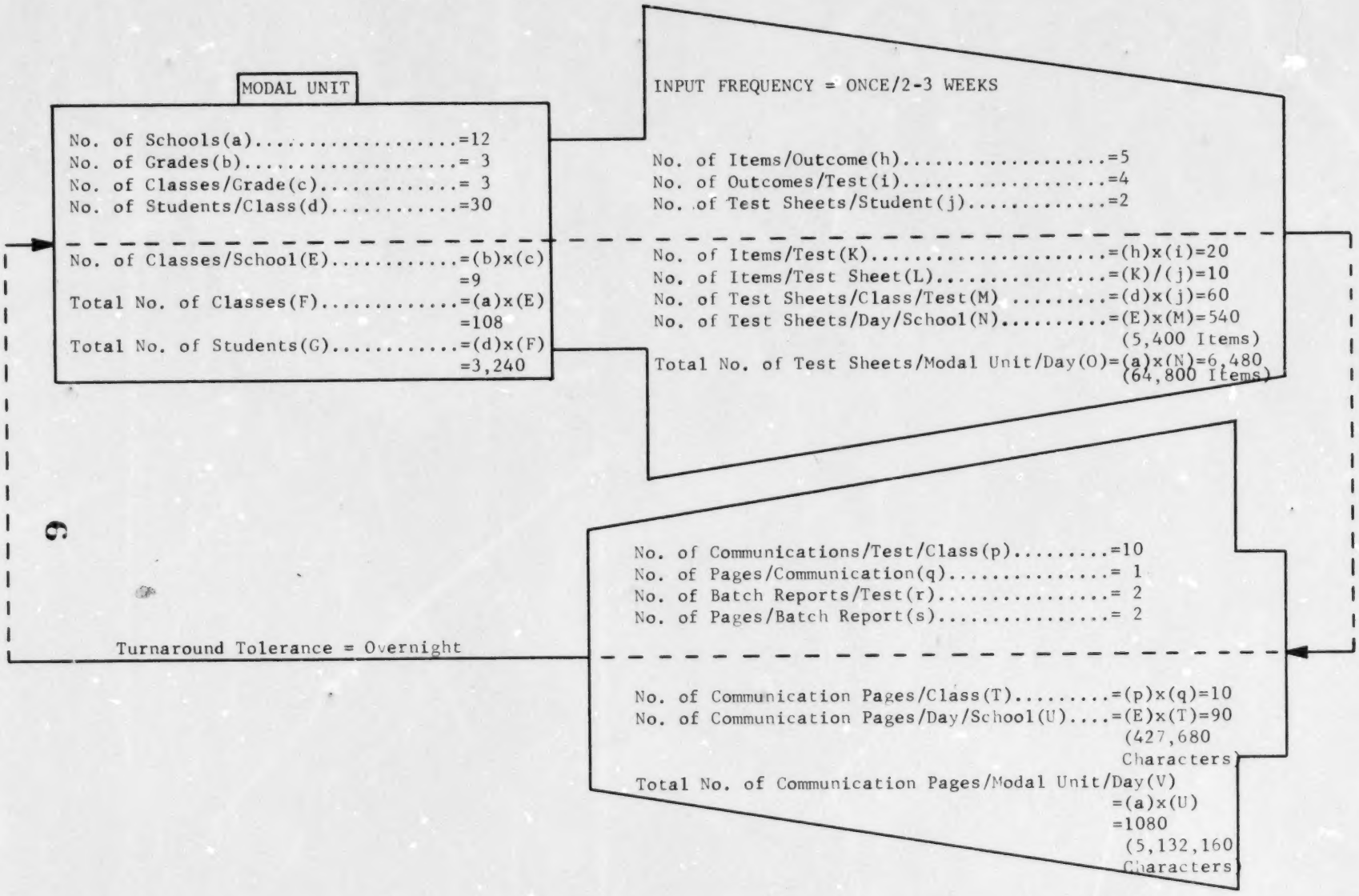
Either minimization of costs, or maximization of benefits and effectiveness of the configurations is sought. Marginal costs*, rather than average or total costs, will ordinarily be considered. Since there will be a number of alternative ways of forming one or more configurations (and later, innumerable alternative ways of improving the effectiveness

*Marginal costs are the costs of one additional unit of production, activity or service. They are the incremental (first derivative) costs of increasing the volume of business output one unit.

Fig. 1. School, Test, and Report Structural Characteristics

	CHARACTERISTICS	RANGE		MODAL UNIT
		LOWER	UPPER	
SCHOOL STRUCTURAL	Size of District	1 School	1 State	1 Local Educational Agency (LEA) of 12 Schools
	Grades	K.G.	8	1-3
	Number of Classes/Grade	1	8	3
	Number of Students/Class	10	60	30
TEST STRUCTURAL	Number of Items/Outcome	5	20	5
	Number of Outcomes/Test	1	8	4
	Number of Sheets/Student	1	4	2
	Frequency	Daily	Monthly	2-3 Weeks
REPORT STRUCTURAL	Number of Audiences/Test	1	6	4
	Length of Communication	1 Line	2 Pages	1 Page
	Number of Communications/ Test	1	50	10
	Number of Batch Reports/ Test	1	6	2
	Number of Pages/Batch Report	1	50	2
	Turnaround Tolerance	Interactive	1 Week	Overnight

Fig. 2. Frequency/Quantity of Data/Information Flow in the Modal Unit


MODAL UNIT
No. of Schools(a).....=12
No. of Grades(b).....= 3
No. of Classes/Grade(c).....= 3
No. of Students/Class(d).....=30
No. of Classes/School(E).....=(b)x(c) =9
Total No. of Classes(F).....=(a)x(E) =108
Total No. of Students(G).....=(d)x(F) =3,240
INPUT FREQUENCY = ONCE/2-3 WEEKS
No. of Items/Outcome(h).....=5
No. of Outcomes/Test(i).....=4
No. of Test Sheets/Student(j).....=2
No. of Items/Test(K).....=(h)x(i)=20
No. of Items/Test Sheet(L).....=(K)/(j)=10
No. of Test Sheets/Class/Test(M) .....=(d)x(j)=60
No. of Test Sheets/Day/School(N).....=(E)x(M)=540 (5,400 Items)
Total No. of Test Sheets/Modal Unit/Day(O)=(a)x(N)=6,480 (64,800 Items)
No. of Communications/Test/Class(p).....=10
No. of Pages/Communication(q).....= 1
No. of Batch Reports/Test(r).....= 2
No. of Pages/Batch Report(s).....= 2
Turnaround Tolerance = Overnight
No. of Communication Pages/Class(T).....=(p)x(q)=10
No. of Communication Pages/Day/School(U)....=(E)x(T)=90 (427,680 Characters)
Total No. of Communication Pages/Modal Unit/Day(V) =(a)x(U) =1080 (5,132,160 Characters)

NOTE: Worst possible cases and instances are employed to minimize detailed scheduling, queuing, and probability studies at this stage of the analysis. They will, however, be carried out at later stages to minimize wastefulness of the configurational resources.

of a configuration), marginal costs will have to be estimated to select the best. Marginal ratio of benefits (increase in effectiveness) to costs for each of the alternatives will also be assessed. Effectiveness is maximized, or costs are minimized, only when the marginal ratios of benefits to costs are equal for all the competing alternative ways available for making marginal improvements in a program:

> ...if we reduce the effective payload of an aircraft by 1 in order to save $100 in the materials cost of the fuselage, then we should not simultaneously spend $200 more on the construction costs of the ailerons in order to increase payload by 1 pound. The marginal ratio of cost to benefits should be the same for all the various ways of increasing payload or of increasing any other performance characteristic....we must be sure that our dollars, or our manpower, or our facilities are used in ways that give us the greatest marginal increase in benefits. Unless we equate cost-effectiveness or cost-benefit ratios at the margin, we can be sure that we are not getting the greatest effectiveness from the resources committed to a program. No responsible decision maker can afford to be mindless of this simple and fundamental principle (Fisher, 1971).

Economic Worthwhileness

The service must have a utility to the users that equals or exceeds the sum of the proper costs of making it available to them.

Financial Feasibility

The utilization of the configuration must be financially supportable.

Physical Realizability and Availability

The components of the configuration must be physically available or in specifiable prototype form.

Reliability

This feature concerns the reliability and performance of the configuration over time. The configuration should be reliable with high Mean-Time-Between-Failure (MTBF).

Operability, Maintainability, and Serviceability

The configuration should be easy to operate and maintain, requiring minimal user training. Aesthetics and environmental requirements should be considered for components to be stationed at school sites. Service and repairs must be both on a periodic basis and on-demand, and alternatives for carrying out IMS functions should be available in cases of component malfunction and/or breakdown.

Flexibility, Adaptability, and Expandability

The configuration should be flexible to accommodate reasonably alternative components to meet the needs of the moment and have the capability of expansion to meet new requirements. Rigidity of design should be minimized. Exceptions to conform with existing industrial standards will be explicitly noted.

Security

The configuration should have the capability to reject access and utilization by unauthorized users. This is an essential consideration to protect individual and institutional privacy.

REFERENCE

Fisher, Gene H., Cost Considerations in Systems Analysis, New York: American Elsevier Publishing Company, 1971.